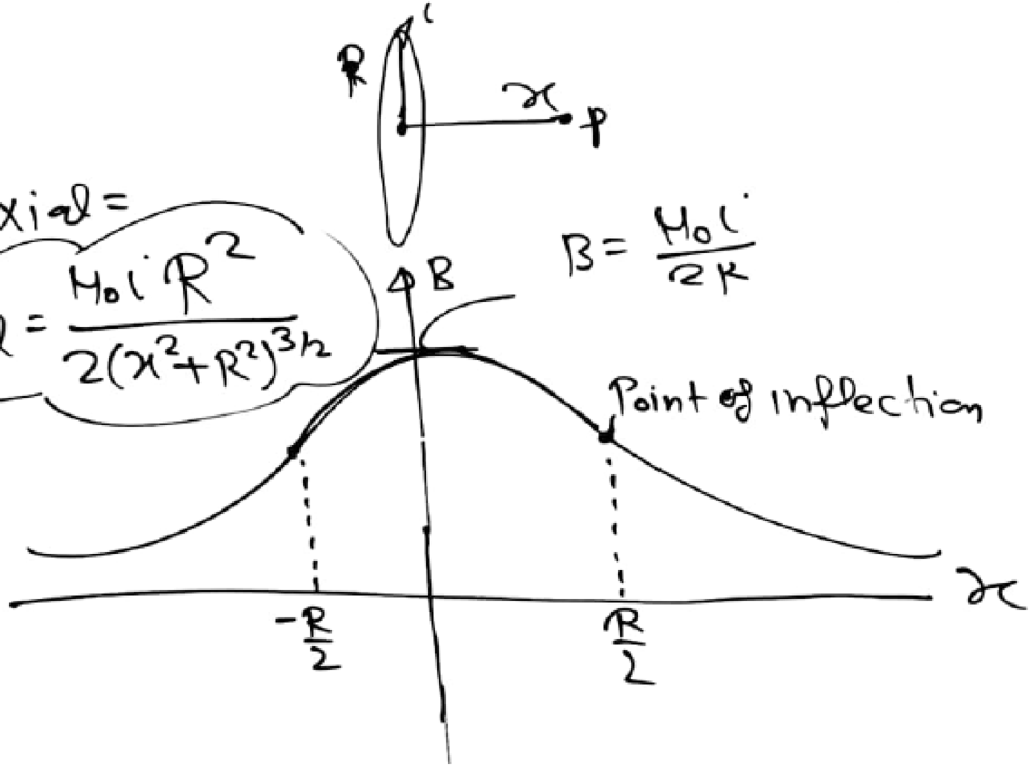
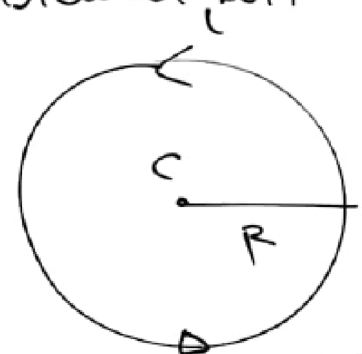
⇒ graph b/w magnetic field B (V/s) x for circular coil




$B_{axial} =$

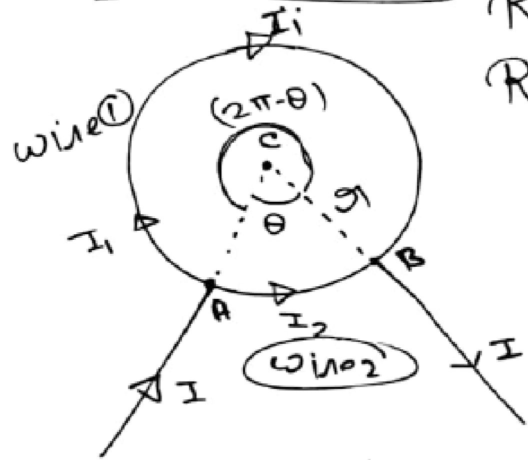
$$B_{axial} = \frac{\mu_0 i R^2}{2(x^2+R^2)^{3/2}}$$

$$B = \frac{\mu_0 i}{2R}$$



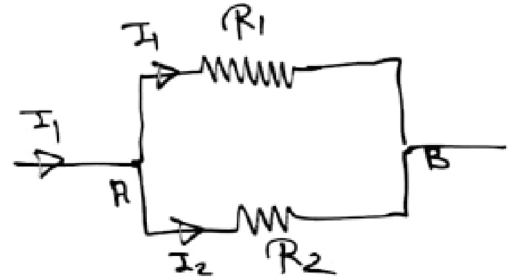

$$B_C = \frac{\mu_0 i}{2R}$$

# Wire → Uniform




$$R_1 = \frac{\rho[(2\pi-\theta)r]}{A}$$

$$R_2 = \frac{\rho r\theta}{A}$$





$$I_1R_1 = I_2R_2$$

$$\frac{I_1}{I_2} = \frac{R_2}{R_1} = \frac{\rho r\theta}{A \times \frac{\rho(2\pi-\theta)r}{A}}$$

$$\boxed{\frac{I_1}{I_2} = \frac{\theta}{(2\pi-\theta)}}$$

$$I_2 = \frac{I_1 \times (2\pi-\theta)}{\theta}$$

$$B_1 = \frac{\mu_0 I_1}{4\pi r}[2\pi-\theta] \quad \otimes$$

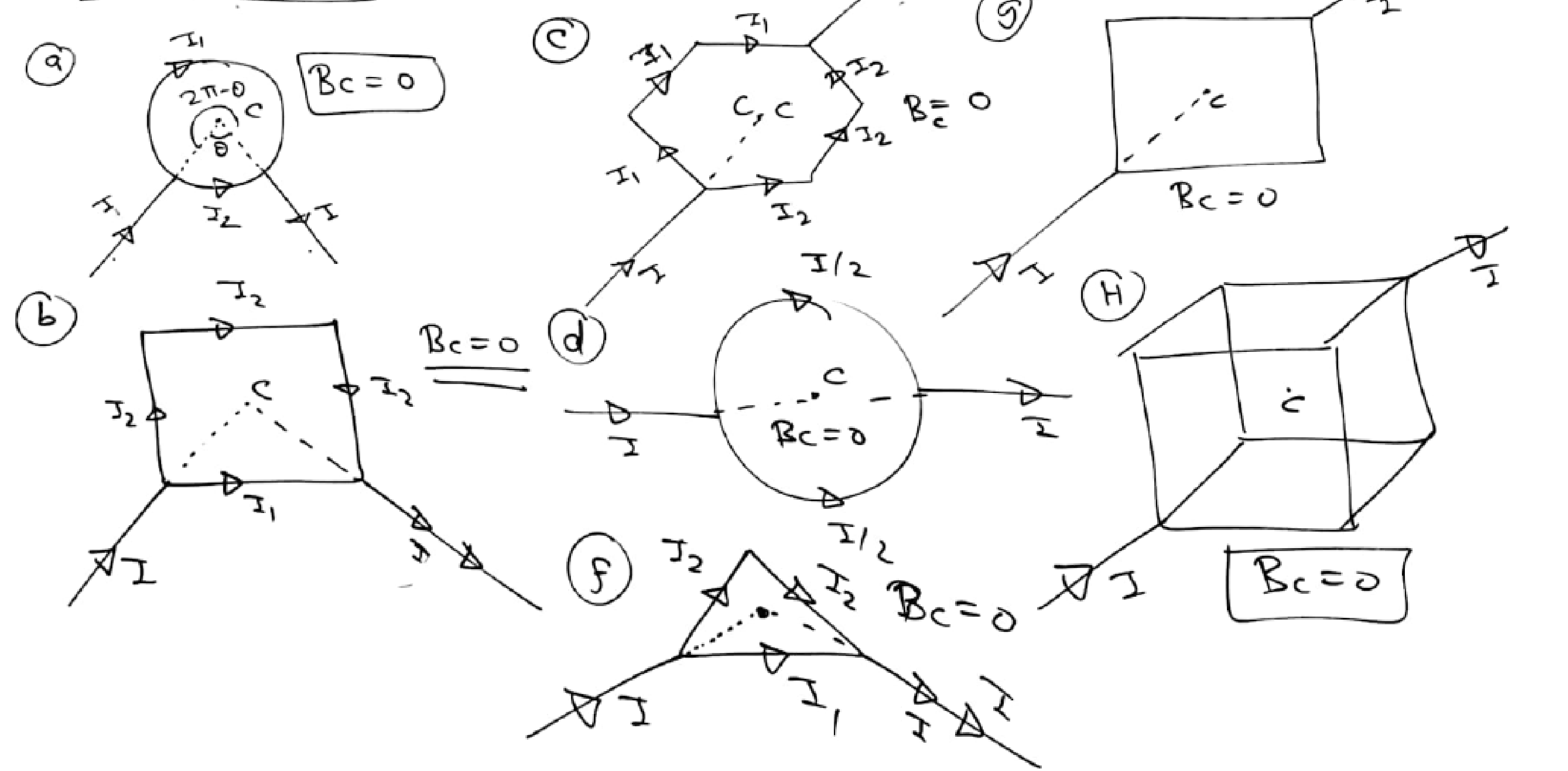
$$B_2 = \frac{\mu_0 I_2}{4\pi r}[\theta] \quad \odot$$

$$B_{net} = B_1 - B_2$$

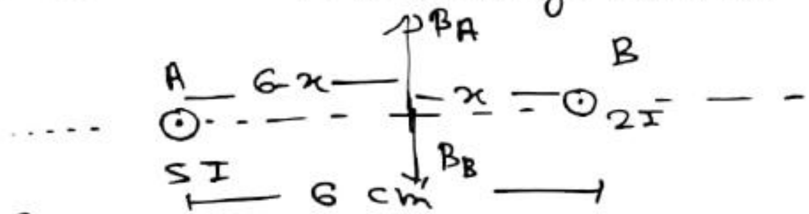
$$B_{net} = \frac{\mu_0 I_1}{4\pi r}[2\pi-\theta] - \frac{\mu_0}{4\pi r}\frac{I_1 \times (2\pi-\theta)}{\theta} \times \theta$$

$$= \frac{\mu_0 I_1}{4\pi r}[2\pi-\theta] - \frac{\mu_0 I_1}{4\pi r}(2\pi-\theta) = 0$$

# Wire → Uniform & same material



Q1) The position of point from wire B, where net magnetic field is zero due to following current distribution




(a) $\frac{6}{7}$ cm.

(b) $\frac{12}{7}$ cm. ✓

(c) $\frac{12}{3}$ cm

(d) $\frac{16}{7}$ cm.

$$B_A = B_B$$

$$\frac{\mu_0 [5I]}{2\pi (6-x)} = \frac{\mu_0 [2I]}{2\pi (x)}$$

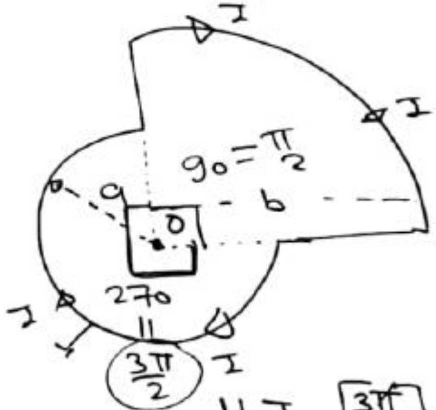
$$\frac{5}{6-x} = \frac{2}{x}$$

$$5x = 12 - 2x$$

$$7x = 12$$

$$x = \frac{12}{7} \text{ cm}$$

Q2) Calculate magnetic field at O.



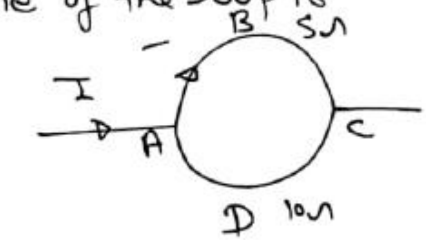

$\theta \times \frac{\pi}{180}$

$$B_a + B_b = \frac{\mu_0 I}{4\pi a}\left[\frac{3\pi}{2}\right] + \frac{\mu_0 I}{4\pi b}\left[\frac{\pi}{2}\right]$$

$$= \frac{3\mu_0 I}{8a} + \frac{\mu_0 I}{8b}$$

$$B_{net} = \frac{\mu_0 I}{8}\left[\frac{3}{a} + \frac{1}{b}\right]$$

Q3) Figure shows a circular loop with radius r & resistance of arc ABC is 5Ω & that of ADC is 10Ω. Magnetic field at the centre of the loop is:

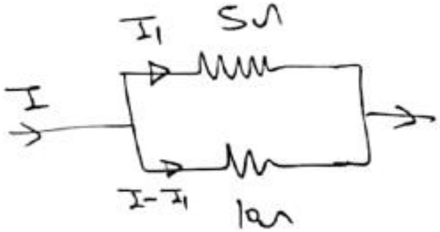



(a) $\frac{\mu_0 I}{6r}$ ⊗

(b) $\frac{\mu_0 I}{12r}$ ⊗

(c) $\frac{\mu_0 I}{12r}$ ⊙

(d) $\frac{\mu_0 I}{6r}$ ⊙




$$\frac{I_1}{(I-I_1)} = \frac{10}{5} = 2$$

$$I_1 = 2I - 2I_1$$

$$3I_1 = 2I$$

$$I_1 = \frac{2I}{3}$$

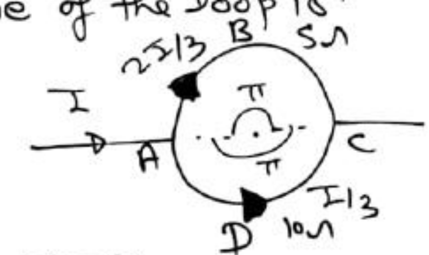
Q3) Figure shows a circular loop with radius $r$ & resistance of arc ABC is $5\Omega$ & that of ADC is $10\Omega$. Magnetic field at the centre of the loop is

(a) $\frac{\mu_0 I}{6r}$ ⊗

(b) $\frac{\mu_0 I}{12r}$ ⊗

(c) $\frac{\mu_0 I}{12r}$ ⊙

(d) $\frac{\mu_0 I}{6r}$ ⊙




$$B_{ABC} = \frac{\mu_0\left[\frac{2I}{3}\right][\pi]}{4\pi r}$$

$$B_{ADC} = \frac{\mu_0[I/3][\pi]}{4\pi r} = \frac{2\mu_0 I}{4\times 3r} = \frac{\mu_0 I}{6r} \otimes$$

$$= \frac{\mu_0 I}{12r} \odot$$

$$B_{net} = \frac{\mu_0 I}{6r} - \frac{\mu_0 I}{12r}$$

$$\boxed{B_{net} = \frac{\mu_0 I}{12r} \otimes}$$

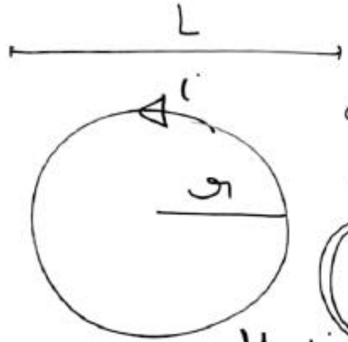
Imp A coil of one loop is made by a wire of length L & there after a coil of two loop is made by same wire. The magnetic field at the centre of coil respectively

(a) 1 : 4

(b) 1 : 1

(c) 1 : 8

(d) 4 : 1




$2\pi r = L$

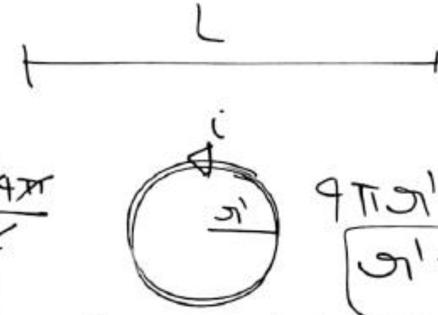
$r = \frac{L}{2\pi}$

$B_1 = \frac{\mu_0 i}{2\left[\frac{L}{2\pi}\right]}$

$B_1 = \frac{\mu_0 i \pi}{L}$

$\frac{B_1}{B_2} = \frac{\mu_0 i \pi}{L \times \mu_0 i \times 4\pi / L}$

$\frac{B_1}{B_2} = 1 : 4$




$4\pi r' = L$

$r' = \frac{L}{4\pi}$

$B_2 = \frac{\mu_0 2 \times i}{2\left[\frac{L}{4\pi}\right]}$

$B_2 = \frac{\mu_0 i \times 4\pi}{L}$


$B_C = \frac{\mu_0 I}{2R}$


$B_C = \frac{\mu_0 N I}{2R}$

Q) The equation of line on which magnetic field is zero due to System of two perpendicular infinitely long current carrying wire is.

(i) $x = y$

(ii) $x = 2y$

~~(iii)~~ $x = 3y$

(iv) $3x = y$

$y = 1$, $x = 3$

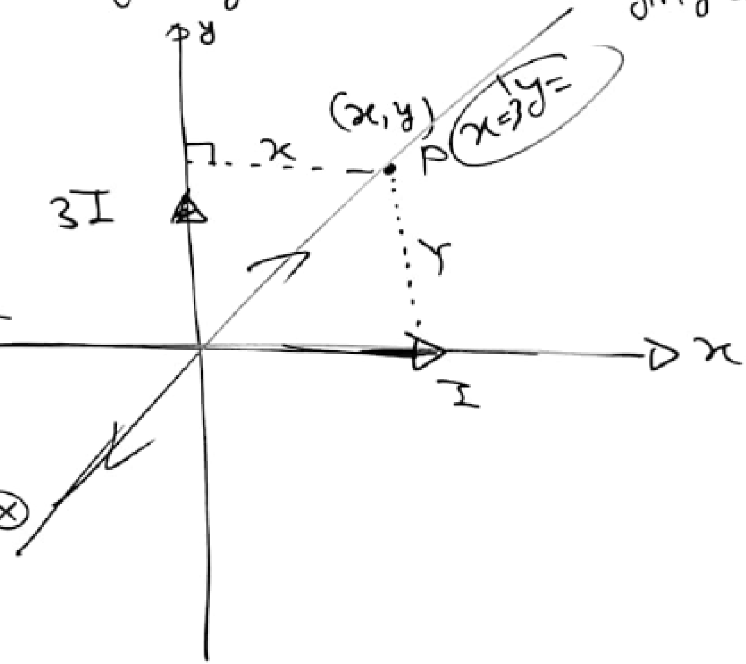
$(3, 1)$

$y = 0$, $x = 0$

$y = 4$, $x = 12$ $(12, 4)$

$$B_x = \frac{\mu_0 I}{2\pi Y} \odot$$

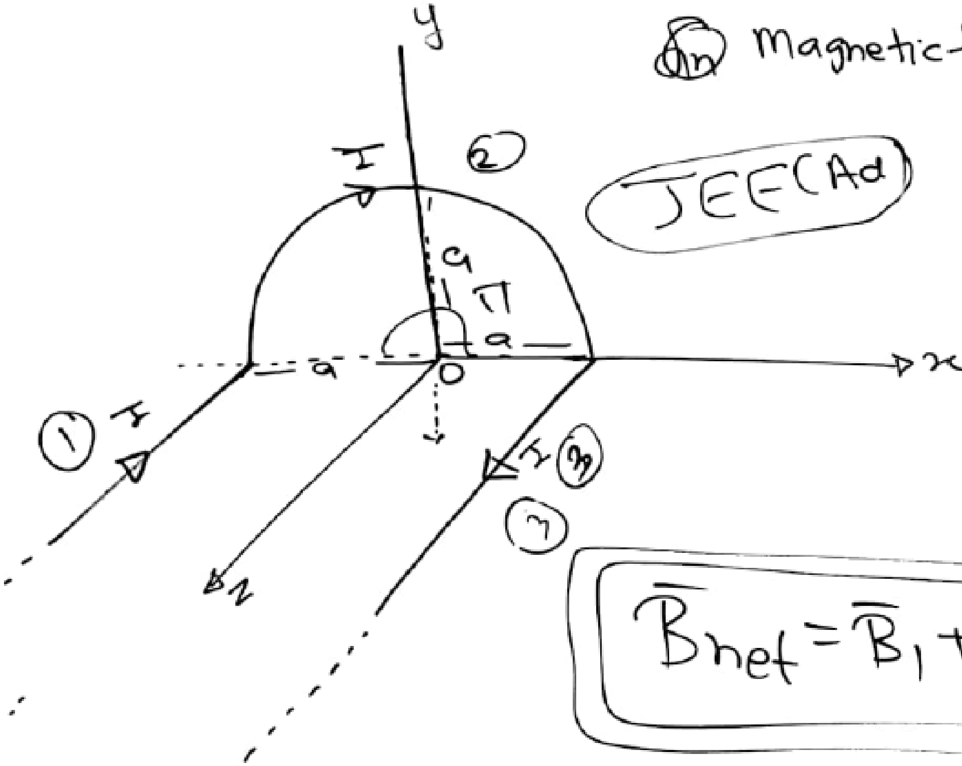
$$B_Y = \frac{\mu_0 (3I)}{2\pi x} \otimes$$




$$B_x = B_y$$

$$\frac{\mu_0 I}{2\pi Y} = \frac{\mu_0 (3I)}{2\pi x}$$

$$\boxed{x = 3Y}$$




JEE (Adv)

Ans magnetic field at O.

$$\vec{B}_1 = \frac{\mu_0 I}{4\pi a}(-\hat{j})$$

$$\bar{B}_2 = \frac{\mu_0 i}{4\pi a}(\pi), \ [-\hat{k}]$$

$$\bar{B}_2 = \frac{\mu_0 i}{4a}[-\hat{k})$$

$$\bar{B}_3 = \frac{\mu_0 i}{4\pi a}(-\hat{j})$$

$$\bar{B}_{net} = \bar{B}_1 + \bar{B}_2 + \bar{B}_3$$